DOCUMENT RESUME

ED 265 025 SE 046 325

TITLE Elementary Science: Alaska Curriculum Guide. First Edition.
INSTITUTION Alaska State Dept. of Education, Juneau.
PUB DATE Aug 85
NOTE 91p.; Support of the Model Curriculum Project was provided through a special grant from ECIA Chapter II (Block Grant).
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS *Behavioral Objectives; *Biological Sciences; *Earth Science; Elementary Education; *Elementary School Science; *Physical Sciences; Problem Solving; *Process Education; Science Careers; Science Education; Science Instruction; State Curriculum Guides; Technology
IDENTIFIERS *Alaska; Science and Society

ABSTRACT

This curriculum guide lists science topics and concepts, learning outcomes, and sample learning objectives (in three columns), separately for grades 1-3 and for grades 4-6. Topics/concepts, in the first column, describe the major parts of the subject under consideration. They define broadly the content to be included in the study of each subject area. These topics/concepts areas include: scientific processes (observing, classifying, using numbers, communicating, measuring, predicting, using space-time relationships, hypothesizing, and others); biological science; physical science; earth/space science; problem-solving and decision-making; science careers; science, technology, and society; science attitudes; cultural and historical context of science; and people and their environment. Learning outcomes, in the second column, describe, in general terms, the behaviors students are expected to demonstrate as a result of their learning experiences. These outcomes are the goals toward which student learning is directed. Sample learning objectives, shown in the third column, are indicators of student progress toward the stated goals. At least one sample learning objective is stated for each learning outcome. (JN)

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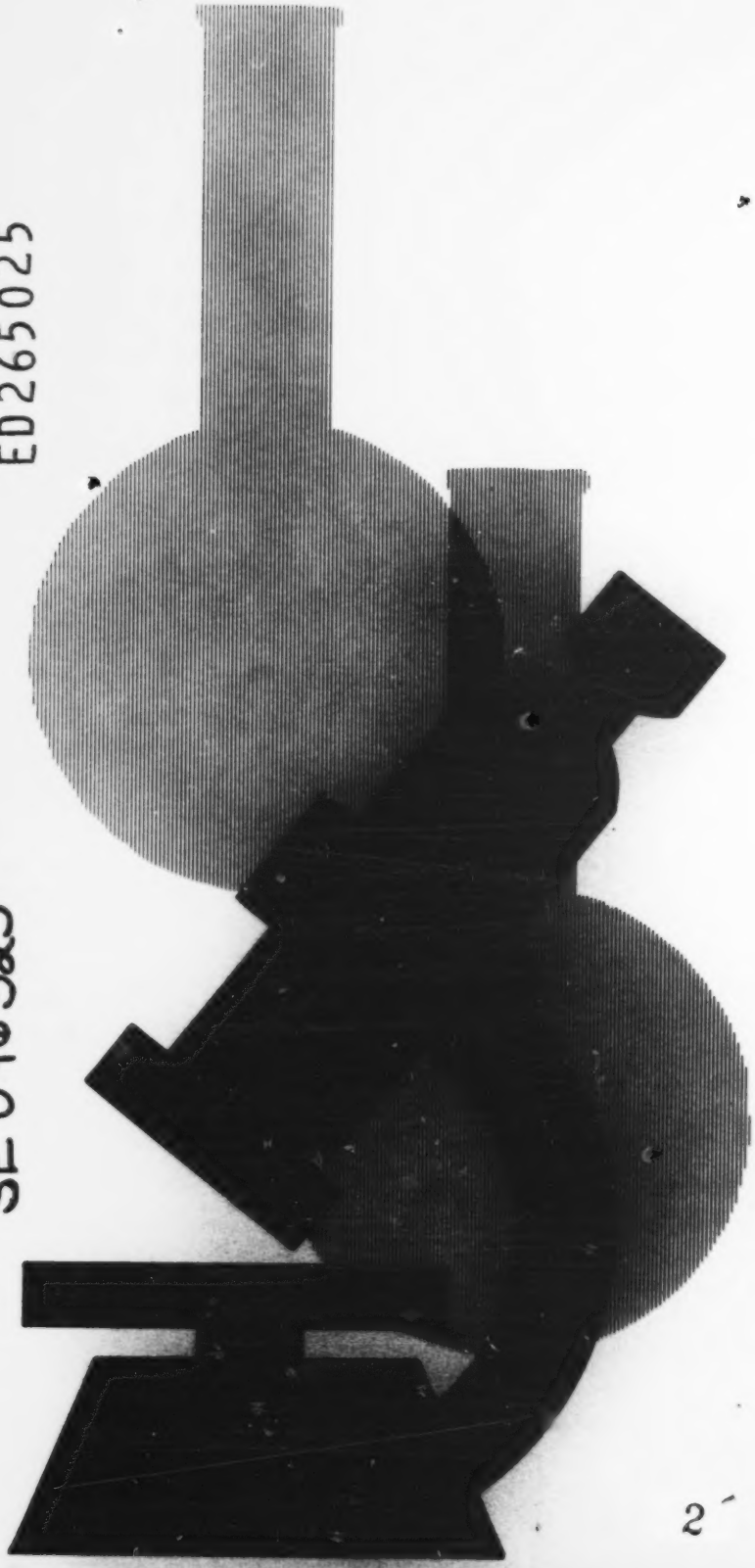

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ELEMENTARY SCIENCE

ALASKA CURRICULUM GUIDE

First Edition

Support of the Model Curriculum Project was provided through
a special grant from ECIA Chapter II (Block Grant)

Alaska Department of Education

August 1985

ELEMENTARY SCIENCE

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"Every great advance in science has issued from
a new audacity of imagination."

John Dewey

PREFACE TO THE SERIES

Among the many decisions that schools must make, none is more important than the choice of curriculum. Curriculum defines the intent behind instruction and the expectations for student performance. This first field edition curriculum guide is one of a series intended to serve as a model to aid school districts as they develop and review their own curriculum documents. It is not intended that any of these field edition guides be used directly by teachers for instructional purposes. Districts are expected to develop their own locally suitable curriculum based on these guides. Districts have or are developing their own locally suitable curriculum using these guides as a base and point of departure. In the future as schools use this material to plan and implement programs, its value will be measured by the increased abilities of students to learn, think, and perform as informed and productive citizens.

In their present form these guides represent a synthesis of input from many sources, both Alaskan and national. They were originally prepared by staff at the Department of Education with the help of professional content associations, Alaskan teachers and administrators. An extensive review and revision process was conducted in 1984-85. School districts, subject matter associations, other professional associations, and interested individuals provided input to a revision process that was contracted to the Northwest Regional Educational Laboratory. A panel of nationally recognized curriculum specialists assisted in the review of each content area. contributors to specific guides are listed in the acknowledgements sections of those guides. In

one sense, these guides will never be finished. It is the intention of the Department of Education that they be dynamic documents subject to revision every few years as part of the six year curriculum review cycle that was recently initiated by new curriculum regulations. Guides exist in the areas of:

Kindergarten	Fine Arts
Language Arts	Social Studies
Science	Computer Education
Foreign Languages (Secondary)	Health
Mathematics	Physical Education

The format of the guides is straightforward but not oversimplified. Each guide lists topics/concepts, learning outcomes, and sample learning objectives in three columns. (In the case of Secondary Foreign Language, the first column is headed topics/skills.)

Topics/concepts, in the first column, describe the major parts of the subject under consideration. They define broadly the content to be included in the study of each subject area.

Learning outcomes, in the second column, describe, in general terms, the behaviors students are expected to demonstrate as a result of their learning experiences. Learning outcomes are the goals toward which student learning is directed.

Sample learning objectives, shown in the third column, are indicators of student progress toward the stated goals, i.e., the learning outcomes. At least one sample learning objective is stated for each learning outcome. It is intended that the sample learning objectives are just that: samples only. They do not constitute a learning program. School districts generate their own locally applicable learning objectives within the framework of their district topics/concepts and learning outcomes.

The guides are grouped by grade level groupings (except Mathematics) -- grades 1-3, 4-6, 7-8 for the elementary level, and 9-12 for the secondary level. Mathematics is presented sequentially grade by grade. Recognizing the unique characteristics of the five year old learner, Kindergarten was prepared as a separate guide. In the development, grades 7-8 were generally seen as the end of the elementary years, but with some beginnings for the secondary level. On the secondary level the guides generally contain discrete courses that would be offered; these are not always tied to a particular grade level as the local district must determine the most effective sequence for those courses.

The Alaska State Board of Education stated, "The Model Curriculum Guides are intended to serve as a model, not a mandate." They underscored the fact that a partnership between state and local school districts is crucial. We seek to promote individual variation while stressing the collective responsibility for educating all students in Alaska. It is in this spirit that the Department of Education welcomes the opportunity for continuous collaboration with those interested in the further development and refinement of this entire series of guides.

PREFACE TO

ELEMENTARY SCIENCE CURRICULUM GUIDE

The current reform movement in science, grounded in research and development, and supported by nationally recognized science educators, suggests that new models of science curriculum need to be developed that focus on interdisciplinary, problem-oriented courses designed to improve and extend a student's conception of science and demonstrate the relevance of science to society.

This new vision of science education calls for a rethinking of instructional goals based on the following:

1) Achievements in science and technology contribute to much of the cultural and economic uniqueness of our country.
2) Citizens need to be equipped to make decisions that require an understanding of science and technology, including decisions regarding energy, health, the environment, and lifestyles.
3) Students need lifelong learning skills to be able to help define and shape a future that is not entirely predictable.

Therefore, the purpose for developing a model science curriculum for Alaska elementary schools is to provide a set of goals, instructional objectives and choice of subject matter essential for effecting a reform of science teaching that is congruent with modern science, technology and society. The goals of science education in Alaska include the following:

1) To help young people become scientifically and technologically literate citizens in a high technology nation.

2) To help young people become active in shaping and molding the future of a modern science and technology-oriented society and state.

3) To help young people use science knowledge and skills in meaningful ways such as for decision making and lifelong and independent learning.

4) To help young people integrate science skills and knowledge into the core curriculum, and assist them in considering careers in science and technology, and preparing for college.

5) To help young people prepare for the future in terms of science and technology-based personal and social problems that are common to the human experience.

Framework of the Guides

The Elementary Science Curriculum Guide (grades 1-8) reflects topical areas that include the following:

1) Scientific Processes (observing, classifying, using numbers, communicating, measuring, predicting, using space-time relationships, inferring, interpreting data, controlling variables, defining operationally, hypothesizing, designing experiments, formulating models)

2) Biological Science

3) Physical Science

4) Earth/Space Science

5) Problem Solving/Decision Making

6) Science Careers

7) Science, Technology and Society

8) Science Attitudes

9) Cultural and Historical Context of Science

10) People and Their Environment

For each topical area, learning outcomes are written as broad-based educational goals. The outcomes represent a sequential flow of content matter and are based on students' developmental patterns. Sample learning objectives are given for the outcome statements, written in behavioral terms and also reflect a continuum of specificity.

The intent of the sample learning objectives is to suggest possible ways students might be able to demonstrate their mastery of the learning outcomes. Local objectives should be developed for the same purpose to more accurately reflect student experiences and abilities, available resources and student needs and interests.

ACKNOWLEDGEMENTS

In preparing the Model Curriculum Guides, the Department of Education requested and received copies of curriculum materials from school districts in Alaska, the state's own Centralized Correspondence Study and other state departments of education. The department thanks the following school districts and state departments for submitting materials:

Alaska School Districts

Adak
Anchorage
Annette Island
Bristol Bay
Copper River
Cordova
Craig
Delta/Greely
Fairbanks
Galena
Haines
Iditarod
Kenai Peninsula
Ketchikan
Klawock
Lower Kuskokwim
Lower Yukon
Matanuska-Susitna
Nenana
Nome
North Slope
Northwest Arctic
Pelican
Railbelt
Valdez
Yakutat

State Departments of Education

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Minnesota
Maryland
Nebraska
Nevada
new Mexico
New York
North Carolina
Oregon
Rhode Island
South Carolina
South Dakota
Tennessee
Texas
Utah
Vermont
Virginia
West Virginia
Virgin Islands
Guam

The department appreciates the efforts of its staff who reviewed and synthesized specific content area materials which resulted in this draft Model Curriculum Guide. Contributors in elementary science included:

Sue Baxter
Stacy Liddle
Ray Minge
Linda Shultz
Kelly Tonsmeire

The department also appreciates the efforts of members of the Alaska Science Teachers Association who reviewed and critiqued an earlier draft of this Model Curriculum. Working within very tight timelines, they provided useful and helpful suggestions for how the document could be improved. People who were involved included:

John Butler
Jean Deffendorf
Helen Ferguson
Emma Walton

In addition, several persons contributed their time to reviewing the 1984 Elementary Science Guide. Their comments and suggestions were used in preparing the 1985 Model Science Curriculum Guide. These people include:

Robert Harty, Delta Greely S.D.
Robin Sims, ANDRO
Linda Franne, ANDRO
Marla Browne, ANDRO
Jane Behlke, APU
Virginia Johnson, APU and ASTA
Emma Walton
Ruth Keitz
Louise Ashmun
Carl Reller, Dept. of Environmental Conservation
Sarah Nanuske-Hamilton, Iditarod S.D.
Tom Sheets, Iditarod S.D.
Phyllis Marchese, CCS, DOE
E. Selig
Jane Angvik, The Alaska Native Foundation

The Northwest Laboratory's chief writer for this Elementary Science Guide was Leslie Crohn. Dr. Paul DeHart Hurd, professor emeritus of Standford University, was chief consultant to this NWREL team. Dr. Dana Davidson was consultant on matters of child development. Project design and management was by Dr. William G. Savard of NWREL's Assessment and Evaluation Program. Dr. Gary Estes provided overall direction.

Special thanks are due to Gloria Lerma and Andrea Levy for their cheerful and seemingly endless typing and management of details.

ELEMENTARY SCIENCE
GRADES 1 - 3

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
SCIENTIFIC PROCESSES		
Observing	Know how to observe.	Identify the senses used to describe a variety of Alaskan objects; describe similarities and differences in the objects.
Classifying	Know how to classify objects.	Classify a group of Native Alaskan objects as living or nonliving things.
Using Numbers	Know how to use numbers to measure, classify and order objects.	Use numbers to describe a set of objects, such as fur-bearing animals in Alaska.
Communicating	Know how to use various media to communicate.	Record information from a simple science experience on a computer, on a chart and by pictures. Explain the information to classmates.
Measuring	Know how to measure.	Measure the length of an object. (See also Elementary Mathematics Curriculum Guide.)
Predicting	Know how to predict.	Predict the range of temperature for a given month.

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
SCIENTIFIC PROCESSES (Cont.)		
Using Space-Time Relationships	Understand motion, direction, symmetry, shape and their relationships.	Describe the position of an object as above, below or beside another object.
Inferring	Know how to explain an observation.	Describe a concealed object using senses other than sight; tell what the object is likely to be.
Interpreting Data	Know how to find patterns in data.	Interpret information given in a simple bar graph.
Controlling Variables	Know how to identify the variables in a simple experiment.	Identify the variables that affect the growth of a plant; design a simple experiment that shows how growth is affected when one variable is controlled.
Defining Operationally	Know how to define a thing or event in terms of physical characteristics.	Give definitions of such terms as heat, cold, and light based on past experiences.
Hypothesizing	Know how to generalize and explain in scientific terms.	

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ELEMENTARY SCIENCE
GRADES 1 - 3

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
SCIENTIFIC PROCESSES (Cont.)		
Hypothesizing (Cont.)		Develop a hypothesis for a simple problem such as the effect of noise on living organisms.
Designing Experiments	Know how to plan and design experiments.	Design and conduct a simple experiment, such as growing bean sprouts, to show how plants take in water.
Formulating Models	Understand simple models.	Develop a simple model to explain an observation, such as two balls bouncing at different heights when dropped.
BIOLOGICAL SCIENCE		
	Understand that there are many kinds of living things.	Group pictures or examples of familiar plants, animals, objects into living and nonliving categories.
		Recognize various groups of animals such as birds, sea mammals, etc.
	Understand basic similarities and differences of living things.	

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
BIOLOGICAL SCIENCE (Cont.)		
		Describe and classify different kinds of Alaskan animals by their outer coverings such as skin, feathers, scales or hair.
	Understand that living things grow, develop, reproduce and die.	
		Identify the life sequence of complete insect development, given examples of the egg, larva, pupa and adult stage.
		List examples of animals that are either born alive or hatched from an egg.
		Draw a picture identifying the leaves, stems and roots of a green plant native to Alaska.
	Understand that living things are a product of heredity and environment.	
		Describe habitats of local plants, animals and aquatic life.
		Match pictures of animals with their natural surroundings (environment); match pictures of animals with their offspring.
		Compare the different living conditions (habitats) of two or more animals native to Alaska with the living conditions of two or more jungle animals; describe how the animals adapt to their environments.

ELEMENTARY SCIENCE
GRADES 1 - 3

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
BIOLOGICAL SCIENCE (Cont.)		
	Understand the food chain.	
		Identify foods that can not be recognized from their original form.
		Identify foods that are grown locally and those which are not.
		Discuss how food grown at home or locally can take the place of foods transported from distant places.
	Understand that living things exist in a state of interdependence.	
		Describe an example of an animal/animal pair, each depending on the other to live; describe an example of an animal/plant pair, each depending on the other to live.
	Understand populations.	
		Identify school and classroom populations and subgroups within these populations.
PHYSICAL SCIENCE		
	Know how to classify and describe objects.	
		Group a set of objects according to the following: weight, size, shape, color, texture.

ELEMENTARY SCIENCE
GRADES 1 - 3

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	The Learner will:	The Learner will:
PHYSICAL SCIENCE (Cont.)		
		Arrange a group of objects in a specific order (such as longest to shortest, heaviest to lightest, biggest to smallest) according to the following: length, weight, size.
	Understand that all matter takes up space and has weight.	
		Predict the consequences of an experiment involving a tumbler pushed mouth downward into a bucket of water; explain why the tumbler does not fill with water.
		Predict the consequences of an experiment involving objects placed into a bowl of water; explain why the level of the water rises to different heights.
	Know that matter exists in three states: solids, liquids, gases.	
		Describe the changes which occur when snow melts; describe the conditions which produced these changes.
		Explain why water vapor condenses on the outside of a sealed jar filled with water and ice cubes.
	Understand what change occurs when energy interacts with matter.	
		Explain what happens when a thermometer and the sun's energy are combined after placing a thermometer in the sunlight.

ELEMENTARY SCIENCE
GRADES 1 - 3

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	The Learner will:	The Learner will:
PHYSICAL SCIENCE (Cont.)		
	Know that there are many forms of energy.	
		Describe at least three forms of energy such as electrical, heat, light and water.
	Understand the effects of gravity.	
		Explain why gravity causes objects to fall.
		Sort a collection of objects according to magnetic and nonmagnetic properties.
EARTH/SPACE SCIENCE		
	Know that the sun is the earth's chief source of energy.	
		Explain the consequences of sun and warm temperatures on snow.
		Predict the consequences of a thermometer placed in the sun and a thermometer placed in the shade; explain the differences in temperature.
	Understand that the earth's surface is always changing.	
		Draw four separate pictures showing different weather patterns; explain the causes of snow, rain, blizzards, wind.

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
EARTH/SPACE SCIENCE (Cont.)		
		Describe how the earth's surface has changed around the school, village or town (e.g., areas of erosion, cultivation, weathering) after taking a field trip.
	Understand that day and night are caused by the earth's rotation on its axis.	
		Demonstrate how night and day are caused when given a globe and a light source to represent the sun; demonstrate and explain why some parts of Alaska are dark for long periods of time.
		Define one day as 24 hours or the time it takes the earth to make one rotation on its axis.
	Understand the basic characteristics of outer space.	
		Draw planets, stars and comets and describe their characteristics.
		Tell a story about how life might exist on another planet.
PROBLEM SOLVING/DECISION MAKING		
	Know how to use scientific problem solving and decision making processes.	
		Choose appropriate print and nonprint materials and laboratory equipment, to solve a problem.

ELEMENTARY SCIENCE
GRADES 1 - 3

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	The Learner will:	The Learner will:
SCIENCE CAREERS	Understand how science relates to the planning and fulfilling of personal, social and career life roles.	Report on at least one individual who chose a science career and how the career affected that person's life.
SCIENCE, TECHNOLOGY AND SOCIETY	Understand how science affects technology and how technology affects people and their everyday lives. (See also Elementary Computer Education Curriculum Guide.)	Describe how some recent advancements in technology such as cable T.V., the flights of the Space Shuttle and computers are a result of scientific inquiry; explain how these and other advancements in technology affect life in Alaska. Explain how technology can add to the progress of a school, village, town, state, nation.
SCIENCE ATTITUDES	Know how to use science as a way of learning and communicating about self, others and the environment.	Give an example of how to use print and nonprint materials such as books, thermometers, microscopes or films to seek out and apply science information to his or her everyday life or to solve a personal problem.

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
SCIENCE ATTITUDES (Cont.)		
	Understand how to use science to clarify values, examine issues, solve personal and social problems and satisfy personal curiosity.	
		Discuss how recycling can conserve energy and resources and generate money.
		List items in garbage which can be recycled.
		Discuss how energy can be saved by reusing containers and packaging when shipping.
		Discuss how newspaper can be reprocessed and made into usable paper.
		Use accurate terms for tastes and odors.
		Use accurate terms for feelings and emotions.
	Understand how science contributes to personal experiences.	
		Describe how life in Alaska is different from his or her grandparents' lives.
	Know how to express ideas related to science.	
		Use a variety of media to convey information related to a stated idea, need or problem.

ELEMENTARY SCIENCE
GRADES 1 - 3

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
CULTURAL AND HISTORICAL CONTEXT OF SCIENCE	Know some scientific assumptions, theories, principles, laws, facts and their cultural and historical contexts.	
		Explain why the use of electrical appliances during nonpeak periods helps reduce energy consumption.
	Know some of the conventional language, instruments and operations of science.	
		Demonstrate the proper use of a laboratory instrument appropriate to his or her grade level or course.
PEOPLE AND THEIR ENVIRONMENT	Understand that all waste is disposed of some way, somewhere.	
		Compare the various ways for disposing waste; suggest alternative uses for waste.
	Understand how recycling centers can conserve energy and resources.	
		Compare various recycling operations.
		Describe the process a product goes through in being recycled.
	Understand food production and consumption.	
		Identify the origin of favorite foods.

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
PEOPLE AND THEIR ENVIRONMENT (Cont.)		
		Describe the connection between foods students like to eat and the preservation of the environment.
	Know about home food processing and storage techniques that use little energy.	
		Explain the use of a dehydrator.
		Explain the use of a thermometer.
		Describe some ways of using wasted food.
	Understand that energy can be saved and nutrition improved by growing some of his or her own food.	
		Describe how a seed becomes a plant.
		Illustrate the changes that occur as plants pass through stages of development.
		List some plants that can be successfully started outdoors.
		Discuss regional growing seasons.
		Record the effects of varying light and heat energy inputs on the growth of seedlings.

ELEMENTARY SCIENCE
GRADES 1 - 3

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
PEOPLE AND THEIR ENVIRONMENT (Cont.)		
		Grow some produce and show and describe it to other students.
	Understand that the sun is the primary source of energy to the earth.	
		Discuss how the sun's energy comes to the earth in a variety of ways.
		Discuss other forms of energy in addition to the sun.
		Discuss how the sun's energy is captured by individual plants and transferred to animals through food chains.
	Know how to appreciate the local environment.	
		Identify a variety of local habitats.
		Use the senses to identify aspects of the natural environment.
		Identify relationships between habitats and local uses.

ELEMENTARY SCIENCE
GRADES 4 - 6

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
SCIENTIFIC PROCESSES		
Observing	Know how to observe.	
		Identify at least three properties common to a group of related objects.
		Observe Alaskan wildlife including fish, birds, aquatic insects, etc. and record information about behaviors.
		Observe the function of different fish fins and describe the observations.
Classifying	Know how to classify.	
		Classify a group of Alaskan objects according to observed characteristics.
		Sort and classify the three main types of fish.
		Categorize mammal and marine mammal characteristics.
Using Numbers	Know how to use numbers to measure, classify and order objects.	
		Use at least one of the four basic mathematical operations to describe the results of an experiment.
		Use formulas such as the conversion of metric to English system. (See also Elementary Mathematic Curriculum Guide.)

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
SCIENTIFIC PROCESSES (Cont.)		
Communicating	Know how to use various media to communicate.	
		Make a drawing, chart, or other pictorial display to describe the results of a science experiment.
Measuring	Know how to measure.	
		Read a tide table.
		Graph local tides.
		Measure, of varied objects, volume, mass, weight, temperature, area, length, using appropriate metric units and metric measuring devices. (See also Elementary Mathematics Curriculum Guide.)
Predicting	Know how to predict.	
		Complete a histogram (bar graph) that displays the learner's growth pattern including height and weight. Predict personal growth to age 18.
		Calculate salmon survival potential in nearby Alaskan waters.
Using Space/Time Relationships	Understand motion, direction, symmetry and shape and their relationships.	
		Determine the average speed of a moving object.

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
SCIENTIFIC PROCESSES (Cont.)		
Inferring	Know how to explain an observation.	
		Make inferences about future weather patterns after observing current weather conditions and given appropriate data on such conditions as temperature, moisture and wind.
		Discuss how Native people predict the weather.
Interpreting Data	Know how to find patterns in data.	
		Analyze data collected on a field trip.
		Research life in rural Alaska to determine special problems for home heating and electric generation; report on the potential for use of solar power, wind power, geothermal heat, tidal power and hydroelectric power.
Controlling Variables	Know how to identify and manage the variables in experiments.	
		Design a simple experiment to test Newton's 3rd law: "For every action, there is an equal and opposite reaction".
Defining Operationally	Know how to define a thing or event in terms of physical characteristics.	
		Describe a simple toy or gadget with moving or working parts in terms of what it is, how it is used and how it works.
Hypothesizing	Know how to generalize and explain in scientific terms.	

ELEMENTARY SCIENCE
GRADES 4 - 6

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
SCIENTIFIC PROCESSES (Cont.)		
Hypothesizing (Cont.)		Make at least two hypotheses to explain why a bulb is not burning when given a diagram of an open circuit consisting of a bulb, battery and wire.
Designing Experiments	Know how to plan and design experiments.	
		Design a simple experiment using live fish.
		Design an experiment to test some common foods for fat (such as rubbing a portion of the food on a brown paper bag--foods with fat content will turn the bag translucent); make a report on the amount of fat consumed by the average student in Alaska.
Formulating Models	Understand simple models.	
		Describe what a scientific model is and give an example.
BIOLOGICAL SCIENCE		
	Understand the basic characteristics of plants.	
		Make a drawing showing the major parts of plants such as leaves, stems, roots and flowers; describe the function of each part.
		Identify plants Native people use for medicines.

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	The Learner will:	The Learner will:
BIOLOGICAL SCIENCE (Cont.)		
		Name at least four plant groups such as algae, fungi, masses, ferns, seed plants, etc.
	Understand the basic characteristics of animals.	
		Make a chart showing different animal groups and draw examples of animals in each group.
		List the basic characteristics of animals and describe their basic needs.
	Understand that life is cyclical in nature.	
		Identify the sequence of salmon life cycle stages as egg, alevin, fry, smolt and adult.
	Know that the cell is the basic unit of living things.	
		Select from a list, those organisms such as the amoeba and the paramecium, which are composed of one cell.
PEOPLE AND THEIR ENVIRONMENT		
	Understand the food chain.	
		Diagram the role of herring in the ocean's food web.

ELEMENTARY SCIENCE
GRADES 4 - 6

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
PEOPLE AND THEIR ENVIRONMENT (Cont.)	Understand that concern for preservation and wise use of the environment are necessary functions of responsible citizens.	Define ecosystem as an intricate unit in which all living organisms interact among themselves and their environment. Make a report describing how the quality of life in Alaska is affected by such factors as water, air, natural resources, population, cultural, economic, social, political conditions, etc. Make a mural of salmon habitat and hazards. Discuss methods for conserving energy, including how Native people who live in the Arctic conserve heat and insulate their homes. Discuss utilization and conservation of natural resources, including how Native people utilize resources for food, clothing, and utilitarian purposes. Discuss techniques used by Native people to preserve resources and what resources they use that are not commonly used by non-Natives such as seal oil for food, preservative and light and shark skin for sand paper.

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
PEOPLE AND THEIR ENVIRONMENT (Cont.)		Explain how different groups in Alaska have manipulated and changed the environment and for what purposes. Research and report on some individual acts which have significantly altered the environment.
	Understand that energy manifests itself in many usable forms: plants, wind, heat and light.	Identify the sun as the basic source of energy on earth. Explain how transformation of sun energy to other energy forms provides food, fuel and power for life systems and machines. Categorize any event or object as energy source, energy converter or energy user. Cook something using solar energy. Identify ways to appropriately match the energy source with the energy use in the food production system. Discuss how wind can be used to do many types of work (sailboats, drying, pumping water, etc.). Discuss how wind is not constant and this variability causes problems for users.

ELEMENTARY SCIENCE
GRADES 4 - 6

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	The Learner will:	The Learner will:
PEOPLE AND THEIR ENVIRONMENT (Cont.)		
	Understand how the sun's energy is captured by individual plants and transferred to animals through food chains.	
		Discuss how energy is lost through breathing, heating and moving.
		Discuss how the body gets its energy from the sun through food.
		Describe how human food chains depend on fossil fuels.
		Discuss how energy can be neither created nor destroyed.
	Understand that all waste is disposed of some way, somewhere.	
		Report on the effect of waste on the environment.
PHYSICAL SCIENCE	Know the characteristics of different kinds of matter.	
		Collect samples of matter such as wood, glass, metal, cloth, etc., and describe the characteristics of each, using the processes of observation, measurement, classification and experimentation.
		Design an experiment to show matter changing from one state to another such as from a liquid to a gas.

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
PHYSICAL SCIENCE (Cont.)		
		Describe differences between salt water and fresh water after evaporation has occurred.
		Identify properties of water in different water habitats.
	Understand solutions.	
		Make a solution such as sugar and water or salt and water; define the terms homogeneous, solvent, solute and diffusion as they relate to solutions.
	Know that some solids are composed of crystalline structures.	
		Design an experiment to produce a crystal from a solute after the solute evaporates, such as making rock candy sugar crystals; define saturated and supersaturated solutions.
		Draw at least three crystal structures.
		Define atoms and molecules as particles which make up all matter and explain how crystals have been used to discover the size and shape of many different atoms and molecules.
	Understand basic characteristics of energy.	
		Give examples of matter which have potential energy and examples of matter which have kinetic energy.

ELEMENTARY SCIENCE
GRADES 4 - 6

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
PHYSICAL SCIENCE (Cont.)		
		Describe some different forms of energy such as chemical, electrical, heat and light; give examples of energy occurring as a result of interaction such as a switched-on flashlight or a burning candle.
		Develop a plan to conserve energy in the home, school, village, or town and predict the outcome if the plan were put into effect.
		Demonstrate that electric current produces magnetism using a battery, wire, and magnetic compass.
		Test some different materials to determine if they are conductors or nonconductors of electricity.
	Understand basic characteristics of pure substances (compounds and elements).	
		Define compounds and elements and give examples of each.
		List the most common elements found in food and which make up human beings (carbon, hydrogen, oxygen, nitrogen).
	Understand basic characteristics of sound and light.	

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
PHYSICAL SCIENCE (Cont.)		
		Demonstrate and describe, using a prism, how colors are formed.
		Design an experiment to show how sound is produced.
	Understand the relationship between work and machines.	
		Give a simple definition of work.
		Describe at least two simple machines such as the lever and inclined plane and how they are used in everyday life.
		Give some examples of a compound machine.
EARTH/SPACE SCIENCE		
	Understand how forces change the earth and affect land and water formation.	
		Illustrate how mountains, valleys and oceans are formed.
		Make a report describing how such natural processes as climate, weathering, earthquakes and volcanoes have changed land and water formation in Alaska.
		Illustrate the effects of water on soil formation and erosion.

ELEMENTARY SCIENCE
GRADES 4 - 6

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
EARTH/SPACE SCIENCE (Cont.)		
	Understand the basic composition of the earth.	
		Make a drawing showing the layers of the earth as a cross-section; label the sections.
		Identify the three basic rock types found in the earth: sedimentary, metamorphic, igneous.
		Describe the difference between rocks and minerals.
		Design an experiment to demonstrate that air has weight and occupies space; identify the components of air.
		Make a list of natural resources found in Alaska.
	Understand weather and climate.	
		Differentiate among clouds over a set period of time through observation; illustrate the changes in cloud formation.
		Explain how factors of temperature, water, land features and wind affect Alaska's climate.
		Compare and contrast Alaska's climate with Hawaii's climate.
		Identify the factors necessary for weather prediction such as temperature, moisture, atmospheric pressure.

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
EARTH/SPACE SCIENCE (Cont.)		
		Discuss how Native hunters need the ability to predict the weather and judge hunting conditions including ice conditions, tides, currents and winds.
	Understand hydrologic cycle and water systems.	
		Map local watershed.
		Diagram the hydrologic cycle.
		Measure stream and flow temperatures.
	Know that the solar system is a part of the universe and includes the sun and its planets, meteors and comets.	
		Illustrate the planets and their distances from the sun.
		List the nine planets and give one characteristic of each.
		Choose one planet and develop a scenario of what it would take to support life; support the scenario with data.
		Research meteors, meteorites and comets and describe the characteristics of each.
		Prepare a report giving one theory of the origin of the universe; support the position with data.

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
EARTH/SPACE SCIENCE (Cont.)		
		Describe stars and galaxies.
	Understand basic characteristics of space travel.	
		Explain why rockets are needed for space travel.
		Give some examples of by-products obtained from the space program which are beneficial to humans.
PROBLEM SOLVING/ DECISION MAKING		
	Know how to use scientific problem solving and decision making processes.	
		Make a drop and catch bucket and determine from a set of given objects which object has the largest volume and which has the smallest volume.
SCIENCE CAREERS		
	Understand how science relates to personal, social and career life roles.	
		Research wildlife biologists in Alaska; make a report showing how the work of these people relates to their personal life goals.
SCIENCE, TECHNOLOGY AND SOCIETY		
	Understand how science affects technology and how technology affects people and their everyday lives. (See also Elementary Computer Education Curriculum Guide.)	

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
SCIENCE, TECHNOLOGY AND SOCIETY (Cont.)		Describe how his or her life would be different without snowmobiles; compare and contrast with the lives of his or her grandparents.
		Discuss current technological innovations adopted by Native people such as drums with plastic covers, or skin boats with fiberglass rims.
	Know some significant scientific assumptions, theories, principles, laws, facts and their historical contexts.	
		Make a list of some ways he or she could eat a healthier diet using less energy (for example, a diet of local food as opposed to food imported from thousands of miles away).
		Discuss how Native people predict the weather.
	Know some of the conventional language, instruments and operations of science.	
		Demonstrate the proper use, care and respect for a laboratory instrument appropriate to his or her grade level or course.
	Understand Alaska fishing industry and its interrelationship with human society.	
		Report on gillnetting, purse seining, trolling, longlining, shrimping and crabbing.

ELEMENTARY SCIENCE
GRADES 4 - 6

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
SCIENCE, TECHNOLOGY AND SOCIETY (Cont.)		Report on international law and fisheries. Discuss boat languages and nautical terms and usages in literature, art and music. Plan necessary boat safety practices. Survey grocery stores and make a report on fish and sea products. Plot the origins of the local stores' seafood on a world map. Develop a profit and loss statement and investment analysis for stockholders. Interview fishers or those in fishery-related jobs about their work and its importance in society.
SCIENCE ATTITUDES	Know how to use science as a way of learning and communicating about self, others and the environment.	Make a report describing how his or her life would be different without electric power.

TOPIC/CONCEPT	LEARNING OUTCOME The Learner will:	SAMPLE LEARNING OBJECTIVE The Learner will:
SCIENCE ATTITUDES (Cont.)		
	Know how to use science to clarify values, examine issues, solve personal and social problems and satisfy personal curiosity.	
		Make a report describing the role of electricity in growing, gathering, catching or killing food commonly found in his or her diet.
	Understand how science contributes to personal experiences.	
		List the types of things he or she does for recreation and indicate those activities which require electricity.
	Know how to express ideas related to science.	
		Demonstrate and describe how white light is made of many colors.
	Know how to initiate novel and personal ideas related to science.	
		Make a report on flight and rocketry including what it means when a jet breaks the sound barrier; include a diagram to describe the sonic boom caused by jet planes.

ALASKA CURRICULUM GUIDE: Elementary Science

RESPONDENTS	PROBLEMS, ISSUES, CONCERNS	DISPOSITION
Robert Harty, Delta Greely S.D.	Some communities may not want the strong emphasis on personal, family, self-concept, decision making, emotional areas. Prefers an emphasis on such concrete areas as anatomy, senses, dental care, food, disease.	The external consultants, as well as a number of reviewers from Alaska felt the guide should reflect current thinking regarding science education; i.e., related to practica' and everyday life. However, additional outcomes and objectives have been added in the concrete areas mentioned.
Robin Sims, ANDRO	Grades 4-6	
	Submitted list of sample learning objectives, specific to Alaska, to include.	These have been incorporated into the material to the greatest extent possible.
Linda Franne, Marla Browne, ANDRO	Grades K-3	
	Need to include resources education.	Done.
	Gear the curriculum to people, resources and their concerns.	Done.
	Included a list of objectives to add.	These have been incorporated into the material.
Jane Behlke to Virginia Johnson, APU	Audioconference is a good way to build a list of objectives.	Agreed.

RESPONDENTS	PROBLEMS, ISSUES, CONCERNS	DISPOSITION
Jane Behlke to Virginia Johnson, APU (Cont.)	Best kind of science education involves investigation of things around us.	Agreed, and the guide now reflects this to a limited extent.
	There should be a mandated evaluation instrument.	Agreed, although development of such an instrument is outside the scope of this project.
	It is more important to design a document for teachers.	The curriculum guides developed for this project were intended for use by curriculum directors and specialists.
Emma Walton to Ruth Keitz	The guide is too traditional and doesn't reflect current science thinking.	Agreed and appropriate revisions have been made.
	There needs to be more emphasis on space and the universe.	Additional outcomes have been added in these areas.
	Add more applied science.	Done.
	Add space science to earth science section.	Done.
	Allow the guide to change and evolve over time; do not let it become static.	This is definitely one intention of this project.
Robin Sims, ANRDE	Submitted a document sharing an interdisciplinary approach to science, social studies, reading, language arts, P.E. and health and foreign language using environmental education objectives.	These have been incorporated into the material to the greatest extent possible.

ALASKA CURRICULUM GUIDE: Elementary Science

RESPONDENTS	PROBLEMS, ISSUES, CONCERNS	DISPOSITION
Virginia Johnson, DOE in conjunction with ASTA and science educators	The guide needs to reach the nonscience-oriented student.	Agreed and the material has been revised to reflect this approach.
	Need to relate science to practical, everyday life.	Agreed and appropriate revisions have been made.
	Include aims for the curriculum: critical thinking, processing, problem solving skills, evaluation, appendix.	This has been done with the exception of the last two which are outside the scope of the project.
Louise Ashmun, from teleconference	The guide needs an evaluation component.	Development of an evaluation instrument was not planned as a function of this project.
Carl Reller, Dept. of Environmental Conservation	Chemistry Only	
	Include environmental chemistry and hazardous waste chemistry.	Done.
	Specific comments written directly on the guide.	These have been incorporated into the material to the greatest extent possible.

ALASKA CURRICULUM GUIDE: Elementary Science

RESPONDENTS	PROBLEMS, ISSUES, CONCERNS	DISPOSITION
Sarah Nanuske-Hamilton, Iditarod S.D.	Specific comments written directly on the guide.	These have been incorporated into the material to the greatest extent possible.
Tom Sheets, Iditarod S.D.	Secondary	
	Need more emphasis on the hands-on and how to accomplish the learning objectives.	More hands-on objectives have been added, however, development of teacher lesson plans are not a function of this project and are left to the discretion of individual teachers.
	Specific comments written directly on the guides.	These have been incorporated into the material to the greatest extent possible.
Phyllis Marchese, CCS, DOE	General Concerns	
	7th and 8th grade life science is more comprehensive than high school biology.	Additional outcomes and objectives have been added to the high school biology course.
	Earth science is split unsuccessfully into earth science and geology; geology has left out earth science, leaving only atmosphere, climate and oceans which does meet the definition of earth science; astronomy and natural resources must be included.	These changes have been made.
	Topics and concepts are mixed together.	The first column of the guide has been revised to include both topics and concepts.

ALASKA CURRICULUM GUIDE: Elementary Science

RESPONDENTS	PROBLEMS, ISSUES, CONCERNS	DISPOSITION
Phyllis Marchese, CCS, DOE (Cont.)	Restructuring is needed throughout.	This has been done.
	The stem "The Learner will..." is often inconsistent with the statement that follows.	These have been carefully checked to ensure consistency.
	Need to examine the guides for correct order of skill and concept building.	Done.
	Outcomes and objectives need to be consistent.	All have been carefully checked and revisions made where necessary.
	The guides should include gifted and remedial courses.	It was decided by the Department in consultation with the Curriculum Cabinet that no remedial courses or programs be included in these guides as the learning outcomes sought are not different from regular courses or programs.
	Delete "mass" from resources and development.	Done.
	Combine earth science and geology; geology course should be more of an in-depth study with additional information on specific concepts.	It was decided to retain the two separate course designations but with additional objectives added.
	Submitted a concept/topic list for earth science.	These have been incorporated into the material to the greatest extent possible.

RESPONDENTS	PROBLEMS, ISSUES, CONCERNS	DISPOSITION
Phyllis Marchese, CCS, DOE (Cont.)	General Science 7-12	
	Process skills and their definitions would be better under learning outcomes.	Agreed and this change has been made.
	Need to make the guide more relevant to the Alaska student and environment.	Done.
	Physical Science	
	Make it more relevant to Alaska and the student.	Done.
	Geology	
	Should be a part of earth sciences.	It was decided to retain the two separate course designations but with additional objectives added.
	Physics	
	Okay as is.	Minor revisions have been made.
E. Selig	Biology	
	Too much "cataloging of living organisms" -- the guide needs a thread such as "adaptation".	This change has been made.
	"Understand the nature of" is too vague; a comparison of anatomy and physiology would be better.	The outcome statements have been revised to reflect this approach to the greatest extent possible.
	Need more emphasis on biological processes and concepts.	Agreed and the material has been revised accordingly.
	Specific comments written directly on the guide.	These have been incorporated into the material to the greatest extent possible.

RESPONDENTS	PROBLEMS, ISSUES, CONCERNS	DISPOSITION
E. Selig (Cont.)	Chemistry	
	Need to add concepts of solutions, solutes and solvents.	Done.
	The concepts given are really topics.	The first column is designed to include both topics and concepts.
	Specific comments written directly on the guide.	These have been incorporated into the material to the greatest extent possible.
	Life Science 7-12	
	Some items are appropriate to high school, others to junior high.	The guide has been revised to reflect sequential development of knowledge and skills.
	It is not clear if students will take biology later; if life science is a high school course for nonbiology students, there needs to be some comparative anatomy and physiology included under adaptation along with a "variety of living organisms."	Additional objectives in these areas have been added.
	Specific comments written directly on the guide.	These have been incorporated into the material to the greatest extent possible.
Jane Angvik The Alaska Native Foundation	Elementary and Secondary	
	The material is generally appropriate and sensitive to Native Americans and Alaska Natives; however, the guides can be strengthened by using references drawn from the environment.	A section entitled "People and Their Environment" has been added to both elementary and secondary levels.

RESPONDENTS	PROBLEMS, ISSUES, CONCERNS	DISPOSITION
Jane Angvik The Alaska Native Foundation (Cont.)	The behavior indicator to be "talkative" is not appropriate to most Alaska Natives.	This has been changed.
	Include more "observation" skills as this approach is still used by many Natives to study and learn.	Done.
	Include the following: o Discussion of utilization and conservation of natural resources. o Discussion of methods for conserving energy.	All have been added to the secondary science guide.
	o Discussion of current technological innovations adopted by Native people.	All have been added to the secondary science guide.
	o Discussion of weather and climate and how Native people predict the weather. o Discussion of utilization of plants.	

ALASKA
MODEL
CURRICULUM
GUIDE
PROJECT

Subject: SCIENCE
Course:
Level: ELEMENTARY
Grade(s): 1-8
Date: 8-20-85

PERCENTAGE OF EDUCATIONAL OUTCOMES

Objective	N	%	Histogram of Percentages (10 20 30 40 50 60 70 80 90 100)
COGNITIVE			
1.10 Knowledge of specifics	12	13	*******
1.20 Knowledge of ways and means of dealing with specifics	10	11	******
1.30 Knowledge of universals and abstractions	5	5	***
2.00 Comprehension	39	41	**********
3.00 Application	7	7	****
4.00 Analysis	11	12	******
5.00 Synthesis	10	11	******
6.00 Evaluation	0	0	
SUBTOTAL	94	100	
AFFECTIVE	0	0	
PSYCHOMOTOR	0	0	
Not Classifiable	0	0	
TOTAL	94	100	

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